VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ

FACULTY OF CIVIL ENGINEERING

ÚSTAV POZEMNÍHO STAVITELSTVÍ

INSTITUTE OF BUILDING STRUCTURES

HORSKÝ PENZION

MOUNTAIN GUESTHOUSE

DIPLOMOVÁ PRÁCE

MASTER'S THESIS

AUTOR PRÁCE — Bc. Matej Roštár

AUTHOR

VEDOUCÍ PRÁCE — Ing. KAREL STRUHALA

SUPERVISOR

BRNO 2018

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
FAKULTA STAVEBNÍ

Studijní program	N3607 Civil Engineering
Typ studijního programu	Navazující magisterský studijní program v anglickém jazyce a prezenční formou studia
Studijní obor	3608T001 Pozemní stavby
Pracoviště	Ústav pozemního stavitelství

ZADÁNÍ DIPLOMOVÉ PRÁCE

Student	Bc. Matej Roštár
Název	Horský penzion
Vedoucí práce	Ing. Karel Struhala
Datum zadání	31. 3. 2017
Datum odevzdání	12. 1. 2018

V Brně dne 31. 3. 2017

prof. Ing. Miloslav Novotný, CSc.
Vedoucí ústavu

prof. Ing. Rostislav Drochytka, CSc., MBA
Děkan Fakulty stavební VUT

PODKLADY A LITERATURA

(1) Směrnice děkana č. 19/2011 s dodatky a přílohami; (2) Katalogy a odborná literatura; (3) Stavební zákon č. 183/2006 Sb. ve znění pozdějších předpisů; (4) Vyhláška č. 499/2006 Sb. ve znění pozdějších předpisů; (5) Vyhláška č. 268/2009 Sb. ve znění pozdějších předpisů; (6) Vyhláška č. 398/2009 Sb.; (7) Platné normy ČSN, EN a ISO; (8) Vlastní dispoziční a architektonický návrh.

ZÁSADY PRO VYPRACOVÁNÍ

Zadání: Zpracování určené části projektové dokumentace pro provedení stavby horského penzionu.

Cíle: Vyřešení dispozice budovy s návrhem vhodné konstrukční soustavy a nosného systému na základě zvolených materiálů a konstrukčních prvků, včetně vyřešení osazení objektu do terénu s respektováním okolní zástavby. Práce bude zpracována v souladu s vyhláškou č. 62/2013 Sb. Obsaženy budou tyto části definované ve vyhlášce: A, B, C a D v rozsahu částí D.1.1 a D.1.3. Dále bude práce obsahovat: studie - předběžný návrh budovy a jejího dispozičního řešení - a přílohovou část, ve které budou doloženy předběžné návrhy základů, případně rozměrů dalších nosných prvků řešené budovy a také prostorové vizualizace budovy. Výkresová část bude obsahovat výkresy: situace, základů, půdorysů všech podlaží, konstrukce zastřešení, svislých řezů, technických pohledů, min. 5 detailů, výkres(y) sestavy dílců, popř. výkres(y) tvaru stropní konstrukce. Součástí dokumentace budou i dokumenty podrobnosti dle D.1.1 bod c), stavebně-fyzikální posouzení objektu a vybraných detailů a případné další specializované části, zadané vedoucím práce.

Výstupy: VŠKP bude členěna v souladu se směrnicí děkana č. 19/2011 a jejím dodatkem a přílohami. Jednotlivé části dokumentace budou vloženy do složek s klopami formátu A4 opatřených popisovým polem a uvedením obsahu na vnitřní straně každé složky. Všechny části dokumentace budou zpracovány s využitím PC v textovém a grafickém CAD editoru. Výkresy budou opatřeny popisovým polem. Textová část bude obsahovat i položky h) "Úvod", i) "Vlastní text práce" jejímž obsahem budou průvodní a souhrnná technická zpráva a technická zpráva pro provádění stavby podle vyhlášky č. 499/2006 Sb. ve znění vyhlášky č. 62/2013 Sb. a j) "Závěr".

STRUKTURA DIPLOMOVÉ PRÁCE

VŠKP vypracujte a rozčleňte podle dále uvedené struktury:

1. Textová část VŠKP zpracovaná podle Směrnice rektora "Úprava, odevzdávání, zveřejňování a uchovávání vysokoškolských kvalifikačních prací" a Směrnice děkana "Úprava, odevzdávání, zveřejňování a uchovávání vysokoškolských kvalifikačních prací na FAST VUT" (povinná součást VŠKP).
2. Přílohy textové části VŠKP zpracované podle Směrnice rektora "Úprava, odevzdávání, zveřejňování a uchovávání vysokoškolských kvalifikačních prací" a Směrnice děkana "Úprava, odevzdávání, zveřejňování a uchovávání vysokoškolských kvalifikačních prací na FAST VUT" (nepovinná součást VŠKP v případě, že přílohy nejsou součástí textové části VŠKP, ale textovou část doplňují).

Ing. Karel Struhala
Vedoucí diplomové práce

Abstrakt

Táto diplomová práca sa zaoberá riešením štvorpodlažného horského penziónu s jedným podlažím podzemným a troma podlažiami nadzemnými na parcele 1953/16 v Nízkych Tatrách na Slovensku. Parcela sa nachádza v katastrálnom území obce Horná Lehota. Návrh horského penziónu sa zaoberá architektonickým, technickým a stavebným riešením objektu podľa požiadavok investora. Podzemné podlažie objektu je navrhnuté z betónových tvárnic, ktoré sú odizolované asfaltovými pásmi a zateplené extrudovaným polystyrénom. Nadzemné podlažia sú navrhnuté z keramických blokov HELUZ, zateplené kontaktným systémom ETICS z minerálnej vaty. Objekt je zatrešený šikmou strechou, zkonštruovanou z drevených priehradových nosníkov, ktoré sú spajané styčníkovými plechmi. Cieľom tohto návrhu je vytvoriť modernú a komfortnú stavbu, ktorá poskytuje príjemné prostredie najmä pre milovníkov turistiky a zjazdového lyžovania ale aj ďalších návštevníkov.

Kľúčové slová

HELUZ, betónové tvárnice, SPIROLL, šikmá strecha, preihradový nosník, dvojplášťová strecha, ETICS, Horná Lehota

Abstract

This diploma is dealing with the solution of four-floor mountain guesthouse with one floor underground and three floor overground on parcel xxx/xx in Low Tatras, Slovak republic. The parcel is situated in the cadastral region of Horná Lehota. The design of the mountain guesthouse is solving the architectonical, technical and building solutions of the object according to the requests of investor. Underground floor is designed from DT concrete blocks, which are waterproofed by the bitumen felts and thermally insulated by the extruded polysytrene. Overground floors are made from ceramic blocks HELUZ and thermally insulated by ETICS system from mineral wool. The roof of the object is made from pitched roof constructed from timber trusses, which are connected by gangnail steel sheets. The purpose of this project is to create modern and comfortable builidng, which provides pleasant environment mainly for fans of tourism and downhill skiing, but also for other visitors.

Key words

HELUZ, concrete blocks, SPIROLL, pitched roof, truss, double-layered roof, ETICS, Horná Lehota.

Bibliografická citace VŠKP

Matej Roštár *Mountain Guesthouse*. Brno, 2018. 40 s., 367 s. příl. Diplomové práce. Vysoké učení technické v Brně, Fakulta stavební, Ústav pozemního stavitelství. Vedoucí práce Ing. Karel Struhala.

Declaration:

I declare, that I worked out this bachelor thesis alone and that I stated all used sources of information.

Prohlášení:

Prohlašuji, že jsem bakalářskou prácu dělal samostatně a že jsem uvedl všechny použité informační zdroje.

V Brně, dne 7.1.2018

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Podpis autora

Matej Roštár

Thanks:

Firstly, I would like to thank my supervisor Ing. Karel Struhala for the willingness, enthusiasm, support, proper leading and usefull advices he has been providing me during the elaboration of this project. Secondly, I would like to thank members of my family. They have always been supportive and have been giving me hand when I needed it the most.

Poďakovanie:

Poprvé, chcel by som poďakovať mojmu vedúcemu práce Ing. Karelovi Struhalovi za ochotu, nadšenie, podporu, správne vedenie a užitočné rady, ktoré mi poskytoval počas vypracovania tohto projektu. Podruhé, rád by som poďakoval členom mojej rodiny, Vždy ma podporovali a podali mi pomocnú ruku, keď som to potreboval najviac.

V Brně, dne 7.1.2018

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Podpis autora

Matej Roštár

Content:

Introduction

This diploma´s thesis deals with the architectonical, technical and structural solution of the mountain guesthouse in Horná Lehota. It has four floors. One of the floors is under ground and it is constructed from the concrete block. Other three floors are overground and are constructed from HELUZ ceramic brick clocks. The shape of the object is rectangular. The underground floor serves mainly for the accomodated guests. It provides them special services such as hot tub, saunas and massages. The first overground floor is mainly created by the kitchen and restaurant, which is accessible also for non-accomodated people. Other two overground floors are only for guests. Each floor provides 6 apartments. The main aim of this thesis was to create comfortable and pleasant mountain guesthouse. Accomodoation capacity of the guesthouse is for 36 people. According to the building envelope the object is low-energy house of class X. The structural system in vertical direction is constructed either from concrete blocks or HELUZ ceramic blocks. Both are thermally insulated. Horizontal structures, namely slabs are designed form prestressed concrete panels SPIROLL.Roof of the object is created from timber truss system covered by folded steel sheets. Obejct is supported by the strip foundations.

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A – ACCOMPANYING REPORT

DIPLOMOVÁ PRÁCE

MASTER'S THESIS

AUTOR PRÁCE — Bc. Matej Roštár

AUTHOR

VEDOUCÍ PRÁCE — Ing. KAREL STRUHALA

SUPERVISOR

BRNO 2018

Content:

A.1 Identification

A.1.1 Information about the project

Name:	Mountain Guesthouse
Location:	Horná Lehota, cadaster Horná Lehota, Slovak republic, cadastral number 1953/16

A.1.2 Information about the builder

Name:	Ján Rosík
Address:	Medveďovo 25, 976 52 Čierny Balog, Slovak republic
Phone number:	+421 924 521 512

A.1.3 Information about the designer

Name:	Bc. Matej Roštár
Address:	Jilemnického 1181/4, 977 01 Brezno, Slovak republic
Phone number:	+421 948 176 404
Email:	matej.rostar@gmail.com

A.2 The list of input data

The input documents which had been used during elaboration of this project are the decision of building office, cadastral map of the area, topographic map of the area and the map of public engineering networks.

A.3 Information about the parcel

The parcel number 1953/16 in the cadastral region Horná Lehota, which is used for construction of the new building object is relatively flat with small slope going to the south direction. This cadastral area has already been modified, because the owner of the plot is also the owner of the neighboring plots and during the construction of the objects on them he also managed to modify the terrain in the subjected plot 1953/16. It is because he planned to build an object on this plot before when he realized the construction work of first apartments located to the north-east direction. Access road to the parcel is from north-west side and it is approximately 6m wide. The shape of the

plot is irregular with total area 2917 m^2. There are public networks of potable water and electricity. Sewer system is not present in the region. During the construction process of the object, new automatic waste treating tank will be placed on the plot. However, design of this waste treatment plant is not part of this project and will be elaborated individually together with other new connections. The neighboring plots will not be separated by any fences. The subjected plot neighbors with 5 other plots. In the south-east side, there are small trees which will be cut down. The plot is covered by short grass. Investor of the building is also the owner of the plots around.

A.4 Information about the object

The object which will be erected on the parcel is going to be completely new and its main purpose is to provide a comfortable and pleasant environment for the visitors. Its estimated lifetime should be 50 years in service. The building object is of rectangular shape without any irregularities. The object has four floors, one in the underground and three overground. This new object is according to the thermal evaluation classified as efficient of class B. The estimated duration of erection is approximately 18 months and the estimated cost of the rough construction is approximately 15 000 000 Kč (app. 600 000 €).

Total built-in area:	726.54 m^2
Built-in area without the terrace and paved areas	562.88 m^2
Built-in volume:	7172.16 m^3
Total usable area:	1885.06 m^2
Usable area of the Underground floor:	464.44 m^2
Usable area of the 1st floor:	477.36 m^2
Usable area of the 2nd floor:	471.62 m^2
Usable area of the 3rd floor:	471.62 m^2
Accommodating capacity:	36
Number of apartments:	12

A.5 Division of the objects into parts

The new construction object is divided into 6 objects according to the coordination situation. There are following objects found in the plot: MOUNTAIN GUESTHOUSE, 2 PARKING LOTS, SEWER CONNECTION, ELECTRICITY CONNECTION, POTABLE WATER CONNECTION and RAIN WATER WASTE CONNECTION. Despite all the listed objects, this diploma thesis mainly deals with the design of the mountain guesthouse. Other stated objects will be designed in individual projects.

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B – SUMMARY TECHNICAL REPORT

DIPLOMOVÁ PRÁCE

MASTER'S THESIS

AUTOR PRÁCE — Bc. Matej Roštár

AUTHOR

VEDOUCÍ PRÁCE — Ing. KAREL STRUHALA

SUPERVISOR

BRNO 2018

Content:

B.1 Description of the parcel

The parcel number 1953/16 in the cadastral region Horná Lehota, which is used for construction of the new building object is relatively flat with small slope going to the south direction. This cadastral area has already been modified, because the owner of the plot is also the owner of the neighboring plots and during the construction of the objects on them he also managed to modify the terrain in the subjected plot 1953/16. It is because he planned to build an object on this plot before when he realized the construction work of first apartments located to the north-east direction. Access road to the parcel is from north-west side and it is approximately 6m wide. The shape of the plot is irregular with total area 2917 m^2. There are public networks of potable water and electricity. Sewer system is not present in the region. During the construction process of the object, new automatic waste treating tank will be placed on the plot. However, design of this waste treatment plant is not part of this project and will be elaborated individually together with other new connections. The neighboring plots will not be separated by any fences. The subjected plot neighbors with 5 other plots. In the south-east side, there are small trees which will be cut down. The plot is covered by short grass. Investor of the building is also the owner of the plots around.
In close neighborhood there are new building objects but every single one of them is more than 20 m away. The parcel is covered by short grass and has few trees on the south-east side. Before the construction work begins, trees should be cut down. There are no protected, flood or undermined areas at the location.

B.2 General description of the object

B.2.1 Purpose of the object

The main aim of the building object is to create comfortable, healthy and pleasant place for people who are searching for getting modern accommodation in the mountain region with special facilities desired nowadays. The building object also provides restaurant services and it is accessible also for non-accommodated people.

B.2.2 Urban and architectural solution

The plot is relatively flat, because it was already modified when realization of the neighboring apartments was done. Entrance to the object is facing north-west side. Apartments are facing all sides. Object is situated more on the south-east direction. From the architectonical point of view, object is divided into several parts. The underground floor contains facilities necessary for the proper operation of the building and its services. Second part of this floor is designed for the accommodated people. They can spend their free time in wellness, sauna they can ask for massage and play table-tennis inside the leisure time room. These two parts are divided and the visitors do not have access to the technical facilities of the building. The first ground floor can be again divided into two parts. First part from the entrance door is mostly for visitors. There is restaurant accessible also for non- accommodated people. In this part also social facilities are placed. Near the entrance door there is the reception and small office of the building´s owner. Second part of this floor is created by the kitchen, technical room for the air-condition system and the social facilities for the employees such as toilets, bathrooms and cloak rooms. The rest is designed for storage of food, dishes etc. The second and the third floor is created only by the accommodating units. The building object provides 36 places for accommodation. 6 apartments of different size are found on every floor. They are more specifically described in the following part B.2.3. The external façade is created from the silicate plaster with fine grains. The color of the façade is light-brown. The windows and doors are triple-glazed and are made from wood of cherry color. The balconies have stainless steel railing with hardened glass panels. The roof of the building object is covered by the folded Ti-Zn steel sheets. The color of the roof is dark grey.

B.2.3 Urban and architectural solution

The disposition of the building object can be divided into several parts. The underground floor is mainly for accommodated people. There are following facilities: wellness, saunas, massages. Second part of this underground floor is equipped by the technical facilities such as boiler room, technical room for air-condition system and the storage rooms. The first ground floor contains restaurant, kitchen and the necessary facilities for the employees, visitors and the owners. The other two ground floors are

only designed for accommodated people. They are created by the apartments. Each floor contains 2 four-bed apartments, 2 three-bed apartments and 2 two-bed apartments. Total number of the apartments in the building object is 12. Each apartment has toilet, bathroom, living-room, small kitchen, one or two bedrooms and the small balcony.

B.2.4 Usage by disabled people

The first floor with restaurant is suitable for disabled people. In front of the entrance ramp for wheelchair is designed. In terms of accommodation, no apartment is designed in a way to satisfy requirements for disabled people.

B.2.5 Safety during usage

All people should act naturally. They should not disturb others by the noisy behavior. It is strictly forbidden to smoke inside the building. Only places possible are balconies.

B.2.6 Basic characteristics of the object

Foundations

The building object is supported by the foundation strips. According to the basic calculation peripheral strips are 1.2 m deep and 1 m wide. Internal load-bearing wall is supported by the foundation strip which is according to the basic calculation 1.4 m wide and 1.2 meters deep. The foundations are designed to be cast from the plain concrete. In the span between the foundations, geotextile is put on the soil and it is covered by compacted gravel. On the compacted gravel layer which is 150 mm thick, concrete with KARI grid is put. Total thickness of concrete layer is 200 mm. For the detailed overview of the foundations see the drawing D1.02.01. The actual design of the foundations and the reinforcement should be elaborated by the structural designer.

Waterproofing

The main waterproofing layer in the underground floor is performed by the bitumen felts in two layers. These two layers, namely Glastek and Elastek, both SBS modified are melted on the concrete slab which lays on the compacted gravel. These waterproofing layers deny the access of moisture inside the building. The important thing is to waterproof the peripheral walls under the ground level. These walls are

created from concrete blocks. Also in this case, bitumen felts are used. SBS modified felts are melted on the walls. Then the XPS Polystyrene STYRODUR 3000 is placed on them freely and poured by the soil.

Vertical load-bearing elements

Peripheral wall of the building objects are created from two different materials. In the Underground floor, concrete blocks which are 300 mm thick, are used. These blocks serve also as a formwork, so it is not necessary to build one. These blocks are filled with the fresh concrete and strengthen by the steel bars. The blocks re waterproofed by the bitumen felts and after that, thermal insulation XPS STRODUR 3000 of thickness 150 mm is used. Before the soil is poured back, dimple membrane must be placed on the thermal insulation to improve the waterproofing properties. The peripheral walls of the other three floors are made from HELUZ Family P38 ceramic brick blocks. They are fixed by the thin-layered mortar recommended by the manufacturer. They are thermally insulated by the contact system ETICS. Mineral wool Nobasil FKD S of thickness 150 mm is used. It is fixed by the universal adhesive over the perimeter of the mineral wool panels and then it is also fixed by the fastener for better stability. Fasteners have to be covered by the corks made from the same mineral wool. For the detailed overview see the Drawings of details. Levelling and connecting layer on the mineral wool is performed by the Baumit - DuoContact adhesive with glass-fibre mesh. After 24 hours it must be coated by the penetration coating and the final layer made from Baumit SilikaTop can be made.

Horizontal load-bearing elements

All slabs of the building object are created by the pre-stressed concrete panels SPIROLL of thickness 320 mm. These panels have to be placed on the building by the crane. Overlapping of the panels on the load-bearing structures is 150 mm. When the placement is done, grouting concrete C16/20 with the KARI mesh 150 x 150 mm is poured on them. The soffit of the slabs is created either by gypsum-boards or suspended ceilings. For the detailed overview see the drawing of compositions. Flooring systems are different among the floors. For the detailed overview see the drawing of compositions. On the second and third ground floor balconies are designed. There are

constructed from reinforced concrete of thickness 150 mm. The proper design of the reinforcement has to be made by the structural engineer. These overhanging balconies would create thermal bridges without insulation so they are insulated by the contact system of thermal insulation. The detailed overview is provided in the drawing of detail B.

Roof

The roof is made from timber trusses which are connected by the gangnail steel sheets. It can be classified as pitched, saddle and double-layered roof which has to be ventilated. The design of the truss is only preliminary. Proper design has to be performed by the structural engineer. Trusses are fixed to the reinforced concrete ring by the threaded rods which are fixed by the chemical anchor. Axial distance between trusses is 1 m Thermal insulation Isover Domo is placed between the trusses. To cut the thermal bridge 60 mm thick layer of additional thermal insulation is put under trusses between the timber laths of the same thickness. Thermal insulation has to be protected against the creation of water vapor. Knauf LDS PE foil is used as the vapor barrier. Soffit is created by the Fire resistant gypsum board RIGIPS th. 15mm. For the detailed overview of the layers see the drawing of the compositions. Roof cover is made from folded Ti-Zn steel sheets. The air space in the roof has to be ventilated. According to the calculation of roof inlets and outlets, ventilation is secured.

Doors and windows

To secure the low costs of energies during usage, triple glazed windows and doors are used. Frame of the doors and windows is made from wood. Cherry color of the windows and doors is designed to create nice contrast between the light-brown facade and the opening fillers.

Type of the windows is VEKRA Natura 94 with U = 0,77 $W/m^2.K$ according to the manufacturer´s data. U- value of doors is U = 0,82 $W/m^2.K$ according to the manufacturer.

B.2.7 Basic characteristics of the building services

The building objects has totally 23 toilets, 14 bathrooms, 9 individual showers, one laundry with dryer one sink for the cleaning and 14 kitchen sinks. Each apartment has its own small kitchen with toilet and bathroom. In the underground floor hot tub and small pool with cold water can be found. All main pipes taking away the waste water are situated underneath the underground floor. The connection between particular floors is secured by the installation shaft. All the pipes are hidden behind the pre-walls or in installation shafts. Central heating system is heated by the pellet boiler. Floor heating can be found in the underground and the first over-ground floor. On the second and third ground floor heat is secured by the radiators. Hot water for the restaurant and all the facilities is prepared centrally in the boiler room. Apartments are equipped by the water heaters.

B.2.8 Fire safety

For the detailed protocol of fire safety in this object see the attachment D1.3

B.2.9 Fundamentals of usage of energies

Whole building is heated by the pellet boilers. In the underground floor and the the first over-ground floor, floor heating system is used. In the second and the third floor, radiators are used as heating elements. Hot water for the first two floors is prepared centrally, whereas apartments are equipped by their own water heaters. Ventilation of the building is secured by two ways. Most of the building is ventilated naturally by the windows and possibly by the doors. In case of wellness and the kitchen, ventilation is secured naturally but also by the air-condition system. The detailed specifications of the building services and the materials used for their proper function are specified by the designer of the building service project..

B.2.10 Protection of the building against negative effects

The building object is well protected against the effects of radon. No other protection is necessary.

B.3 Connection to the infrastructure

There are four connections designed in the object. The first one is sewer connection. Area around does not have its own sewer system so the object will have to have its own automatic sewer-waste treating plant. The details will be specified by the specialists. According to preliminary design it will be placed approximately 10 meters form the object. The second connection is the rain water. Again areas around do not have public rainwater sewer, so the retention tank must be placed on the plot. The thrird connection is electricity connection. It is connected from electric transformer placed near the plot. Transformer transforms high voltage to the low voltage. On the southwest edge of the parcel electric circuit breaker is placed. The other electric box is placed inside the ski storage room in the underground. The fourth connection is potable water connection which is 30 m long approximately. It has the main water-mater pit placed two meters away from the border of the parcel. In this pit there is also main valve for stop the water flow into the building.

B.4 Transportation solution

The parcel is directly connected to the road. The arrival road is not far from the main road passing through the area nearby. There are no bike routes.

B.5 Vegetation and terrain solution

The first thing, which is necessary to be done before the start of construction is to cut the grass. 200 mm of the top soil should be removed and used for terrain modification. Soil form foundation pit and trenches should also be used for modification of terrain. The terrain is slightly sloped so the removed topsoil will be used for surfacing.
The architecture of the parcel (vegetation e.g) is up to the investor. He asked for his own arrangement of the parcel.

B.6 Description of the environmental effect of the building

The object is built from heavy materials such as concrete or ceramic blocks. During the erection of the building lot of waste will be produced. All must be transport to the proper recycling place. During the usage of the building waste will be produced too. The object has to have its own thrashes which have to be regularly transported away.

B.7 Protection of the inhabitants

All needed requirements are fulfilled.

B.8 Organizational principles during construction

The first thing which has to be done is to build connection of water and electricity. Water will be mainly used for drinking, washing or mixing of concrete and the electricity is used for running of the machines and tools. Drainage of the parcel can be natural. The parcel lies next to the access road so it is not necessary to build any new road. The construction waste which will be produced during construction works should be separated into parts. It should be divided into plastic, timber, concrete and others. Timber waste can be possibly used in the future by the investor so it can be stored. Plastic waste should be collected and transported to the recycling place. The rest of the concrete, plasters, adhesives, bricks etc. should be transported to the recycling place too. For the sewage mobile dry toilet (ToiToi type e.g) should be used. There is expectation of big soil movement when digging the underground floor. Soil will be used for planar modification of the parcel. It is important for workers to use proper clothes, shoes and wear protective helmets during the construction process.

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA STAVEBNÍ

FACULTY OF CIVIL ENGINEERING

ÚSTAV POZEMNÍHO STAVITELSTVÍ

INSTITUTE OF BUILDING STRUCTURES

C –TECHNICAL REPORT

DIPLOMOVÁ PRÁCE

MASTER'S THESIS

AUTOR PRÁCE — Bc. Matej Roštár

AUTHOR

VEDOUCÍ PRÁCE — Ing. KAREL STRUHALA

SUPERVISOR

BRNO 2018

Content:

C.1 General information about the object

Investor:	Ján Rosík, Medveďovo 25, 976 52 Čierny Balog
Location:	Horná Lehota, cadaster Horná Lehota, parcel no. 1953/16
Built-in area:	726.54 m^2
Useable area:	1885.06 m^2
Built-up volume:	7172.16 m^3
Total height:	14.2 m
No. of floors:	4

C.2 Earthworks

Before the start of construction works it is necessary to cut the grass and flatten the surface for the easy movement of construction machines. Then it is required to remove 200 mm of topsoil from the ground. The removed topsoil can be stored on upper right part of the parcel (north-east direction). The removed topsoil is used after finishing of construction for surfacing of the parcel because it is slightly sloped. Also it can be used for backfills. Then it is important to set project zero by the help of benches and ropes, so it is possible to measure the depth of the foundation pit. Two benches on the each side of the corners should be used. There are two different levels of the foundation depth. The basic one is 5690 mm the second one is 6490 mm. For the detailed overview see the drawing of Foundations D1.02.01. Total depth measured from the project zero is 6490 mm. Extended pit from external side around the foundation should be digged. It is necessary to do, because of the insulating process of the foundation by STYRODUR in thickness of 150 mm. Width of the extended pit at the bottom should be 600 mm and the slope of the edge of the pit should be 50°. Before allowing people to go inside the pit it is necessary to check the stability of the wall. It should be marked out with lime cement for a good visibility. The project´s zero is set to the 1086,000 meters above the sea level. The depth of the pit should be measured many times to secure the accuracy and proper depth of the foundations.

C.3 Foundations

The foundations are made of the plain concrete which is cast by the pump, so it is necessary to use formwork in the pits. The trenches with formwork are filled with the concrete and at the top of the strips plain concrete reinforced by the the KARI mesh is cast. Grade of the concrete and exact position of the reinforcement should be calculated by structural designer. Before the concrete slab is cast on the whole area of future object, geotextile has to be put on the soil. Then layer of gravel should be put and compacted at total height of 150 mm. When this preparation of the base is done, concrete can be put on it. Then it should be vibrated. It is recommended to remove the formwork after 7 days. Concrete should be left to harden for at least three to four weeks. During this period trenches around the foundation strip can be poured by the previously digged soil. Due to the big depth of the foundations they do not have to be insulated. When the base layer is hardened, waterproofing made from bitumen felts Elastek and Glastek (SBS modified) are performed in two layers. Both layers are melted on the whole area of the base slab. For the application of the bitumen felts must be done with help of fire burner and gas bomb. Application of the waterproofing must be performed by the specialized workers. Process of application can be found on the webpage of the producer. Overlapping of the bitumen felts must be at least 150 mm to secure perfect waterproofing properties. In the peripheral places waterproofing should be melted to the very edge of the foundation strip.

C.4 Vertical load-bearing structure

Vertical load-bearing structures are created from two types of materials. Underground floor is made from concrete blocks of thickness 300 mm and they are filled with the fresh concrete and bounded by the reinforcing steel bars. Walls of the underground floor have to be secured against the moisture. SBS modified bitumen felts have to be melted after the erection. The process is similar to those performed during the waterproofing process of the foundation slab. These underground walls are insulated by the XPS STRODUR 3000 which is freely laid. Dimple membrane is securing the additional waterproofing layer. To get some daylight and to be able to ventilate naturally the underground floor, concrete prefabricated transoms are used. Transoms are put after the thermal insulation and are fixed by the anchors which are screwed to the load-bearing

wall. When this process is finished, the pit which was created during the earthworks can be poured by the soil.
Internal load-bearing wall of the underground floor is also made from concrete blocks with the same thickness of 300mm.
The first ground floor is created from the HELUZ Family ceramic blocks of thickness 380 mm. They are fixed by the thin-layered mortar which is prescribed by the manufacturer. According to the drawings, lintels from the same manufacturer are placed above the openings. The last layer of the first floor is made from reinforced concrete ring, which 250 mm high. To create this layer formwork has to be prepared all around the peripheral and internal load-bearing walls. The proper position of the reinforcement has to be calculated by the structural enginneer. Internal load-bearing walls of the first floor are made from HELUZ Family 30 of thickness 300mm. The other two floors are also made from the same system. The difference occurs in case of openings. Lintels above the windows are created by the reinforced concrete ring which is 250mm thick. It is very important to bind corners properly. The solution of the corners can be found on the website of the manufacturer. All peripheral walls are insulated by the contact system by the mineral wool Nobasil FKD S of thickness 150 mm. It is firstly fixed by the adhesive which is put on the whole area of the mineral wool panels and then glued to the wall. The proper positioning of these panels is described by the manufacturer. These panels are also fixed by the fasteners. 6 fasteners per $1m^2$ have to be used. It is necessary to misconduct the point thermal bridges. For the detailed overview see the drawing of Detail A.

C.5 Horizontal load-bearing structures

All slabs of the building object are created by the pre-stressed concrete panels SPIROLL of thickness 320 mm. These panels have to be placed on the building by the crane. Overlapping of the panels on the load-bearing structures is 150 mm. When the placement is done, grouting concrete C16/20 with the KARI mesh 150 x 150 mm is poured on them. The soffit of the slabs is created either by gypsum-boards or suspended ceilings. For the detailed overview see the drawing of compositions. Flooring systems are different among the floors. For the detailed overview see the drawing of compositions. On the second and third ground floor balconies are designed. There are

constructed from reinforced concrete of thickness 150 mm. The proper design of the reinforcement has to be made by the structural engineer. These overhanging balconies would create thermal bridges without insulation so they are insulated by the contact system of thermal insulation. The detailed overview is provided in the drawing of detail B.

C.6 Roof structure

The roof of the building object is pitched, saddle and double-layered. The load-bearing elements of the roof structure are timber trusses which are connected by the gangnail steel sheets. The trusses are fixed by the threaded rods which are drilled to the reinforced concrete ring. These rods are anchored by the chemical anchor. The proper calculation of the truss must be performed by the structural engineer. The bracing against the wind load is performed by two ways. Sheeting made from OSB/4 boards is applied at the top of the truss, secondary bracing is created by the beams. This bracing is already used during the erection of the trusses. Dimensions of the bracing must be again calculated by the structural engineer. Trusses are prepared transported to the roof by the crane. At the bottom, thermal insulation Isover Domo is put between the bottom ties of the truss. Total thickness is 280mm and it is placed in two layers. In terms of prevention of creation of thermal bridges additional layer of the thermal insulation must be placed below. Isover Domo of thickness 60 mm is used. It is placed between timber laths 60x40 mm which have to be firstly put in the perpendicular direction to the truss system. Thermal insulation is protected against water vapor by the Knauf LDS PE foil which is placed under the additional layer of the thermal insulation and it is fixed by the duct tape and by the nails to the timber laths. All nails has to be overlapped by the special duct tape to get the proper functionality of the vapor barrier. Airtight foil has to be applied on the top of the thermal insulation. The roof is ventilated and the airtightness must be secured. The top part of the truss has to be covered by the additional safety waterproofing. Timber laths 40x60 mm are placed on it to provide ventilation space. They are fixed by the nails to the upper tie of the truss. Sheeting is made from OSB/4 boards, which are nailed to the laths below. Roof cover is made from folded TiZn steel sheet of th.0,7mm. It has to be separated from the OSB boards in case of small condensation to prevent degradation of the roof cover. Separation and micro-ventilation layer Dekten Pro is put between them,

C.7 Partitions

The partitions in the building objects are made from different material. In the underground floor, partitions are made from Ytong Klasik of two different thicknesses. The most of them are 150 mm thick. Some of them are made 100 mm. For the detailed overview of the particular layers of the partition see the drawing of compositions. Ytong partitions are fixed by Ytong thin-layered mortar.

In the rest floors, partitions are made only from the gypsum-boards which are filled by the mineral wool to increase their acoustic and fire resistant properties. The partitions of the total thickness of 200 mm are used to separate the apartments in the second and third floor. They are made from 2 layers of gypsum board RIGIPS 12.5 mm on both sides. Inside of the structure between the supporting galvanized steel profiles, thermal insulation is placed. The second type of partition is made in total thickness of 150 mm. They are used to separate the bedrooms and living rooms. The last type of the partition made from gypsum board is the one with total thickness of 100 mm. These are used to separate toilets and bathrooms form the entrance hall in the apartments. All of the gypsum board partitions have the surface finish modification provided by Baumit Fascina Top scraper and the interior white paint. Technological prescription of the erection of these gypsum board partitions is described by the manufacturer. For the detailed overview of the particular partitions see the drawing of composition.

C.8 Floor above the ground

The main part of the floor in the underground is made from concrete which is reinforced by the reinforcing KARI grid. This concrete is poured on the gravel base 150mm which should be placed before the application of the concrete. Gravel of grain size 16-32mm must be separated from the soil by using geotextile. The concrete layer itself is 200mm thick. After 3 weeks when it is hardened, waterproofing in two layers must be placed in order to deny the access of moisture into the building. These two layers are bitumen felts. Both of them are SBS modified and are melted on the whole area. Thermal insulation is made from EPS 150 in total thickness of 160mm placed in two layers. First layer is 100mm thick, second one 60 mm thick. Dilatation layer form Izoflex PP foil must be placed all around the perimeter. Next layer of the floor is system panel for floor heating tubes. These panels are made from polystyrene of thickness 30mm have special

separating foil on the top. Therefore it is not necessary to place another separation foil before the cement screed is poured. When the floor heating tubes are placed and anchored for their better compactness, cement screed can be poured in total thickness of 55 mm. Floor finish is made from ceramic tiles which are glued by the hydrophobic adhesive. For the detailed composition of the floor see the drawings of compositions.

C.9 Staircase

In the building object we can find two staircases. One of them is considered as main leading from the underground floor to the third ground floor. The second one connects the underground floor and the first floor in the part of employee´s facility. Both staircases are designed from the reinforced concrete. The detailed placement of the reinforcing bars should be calculated by the structural engineer. Each floor of the building has different height. It means that every staircase flight has different slope and height. Width of the risers is in every case 280 mm. Height of the riser changes in individual floors. For the detailed calculation see the folder E. Height of the railing is 900 mm. Proper design will be discussed with the structural engineer. The staircase is planned to be heavy-weight and will be supported by the load-bearing walls.

C.10 Openings

For the filling of the openings there are used triple glazed windows VEKRA Natura 94 with U = 0,77 W/m^2.K. The frame of the window is constructed from the oak timber. Also the doors are produced by this company and have U-value = 0,82W/m^2.K. The windows are fixed by the screw to the base layer created from the concrete created on the ceramic blocks. For the detailed view of window fixing see the detail A. It is recommended to use specialized workers for the correct fixing of windows, because it is important from the point of view of thermal evaluation.

C.11 Chimney

There is only one chimney in the building object. It is triple-layered anti- corrosive chimney, which is used for pellet boiler. This chimney is protected by the insulation inside to deny the creation of condensate which is undesired for the boiler on natural

fuel. Internal diameter for the chimney flue is 200 mm, external diameter is 300 mm. The chimney does not require any protection because it is made of stainless steel. Only necessary thing is to put the head on the top of the chimney to protect the flue against the rain water flowing down. This type of chimney is fixed to the external wall. The height of the chimney is 13 m. Proper design of the chimney should be consulted with the specialized worker.

Conclusion

The main aim of this diploma thesis was to create healthy, nice and comfortable place for visitors.. The design was based on the investor´s requirements. There are few changes in the disposition compared to the study.The staircases are a bit different. Few changes in the room dimensions were made. The external dimensions of the building were not changed. The goal of the project was done as the documentation to the realisation of the building object has been elaborated.

List of used sources

Used standards

ČSN 73 4301 – Obytné budovy

ČSN 73 0532 – Akustika, ochrana proti hluku v budovách

ČSN 73 0802 – Požární bezpečnost staveb

ČSN 73 0580 – Denní osvětlení budov

ČSN 73 0540 – Tepelní ochrana budov

Legislation

Vyhláška 499/2006 Sb., o dokumentaci staveb

Zákon č. 183/2006 Sb., o územním plánování

Vyhláska 23/2008 Sb., o technických podmínkách požární ochrany staveb

Vyhláška č. 501/2006 Sb., o obecných požadavcích na výstavbu

Webpages

www.vekra.cz

www.isover.sk

www.knauf.sk

www.schiedel.cz

www.thermomaster.sk

www.maslen.sk

www.tzb-info.cz

www.fatrafol.sk

www.ytong.sk

www.heluz.cz

www.dek.cz

www.topsave.cz

Used softwares

AutoCAD 2013

Microsoft Office 2010

Adobe Acrobat Reader

List of abbreviations

ČSN – česká státní norma

mm – milimeter

m – meter

U – heat transfer coefficient

th. – thickness

e.g – for example

W – watt

K – Kelvin

no. – number

List of attachments

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1. THERMAL EVALUATION OF CHOSEN STRUCTURES
2. THERMAL EVALUATION OF BUILDING ENVELOPE
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Attachements

See the individual folders on the bachelor´s thesis – folder A, folder B, folder C, folder D, folder E